

# PATENT ABSTRACTS OF JAPAN

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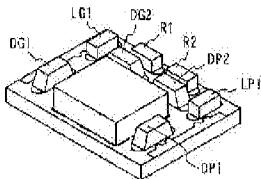
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(54) HIGH FREQUENCY SWITCH MODULE



(57) Abstract:

PROBLEM TO BE SOLVED: To provide a high frequency switch module, which can be miniaturized while maintaining electric characteristics.

SOLUTION: In the high frequency switch module, with which a high frequency switch equipped with a high frequency component, a transmission line and a capacitor is laminated and integrated on a laminated substrate constituted by laminating a plurality of dielectric layers and provided with mutually confronted first and second principal faces and a side face linking the relevant principal faces, the high frequency component is packaged on the laminated substrate, the transmission line and the capacitor are incorporated, the high frequency component packaged on the laminated substrate, the transmission line incorporated in the laminated substrate and a connection line for

connecting the capacitor are located on the dielectric layer close to the first principal face, and a ground electrode comprising the capacitor of the high frequency switch is located between the layers of the transmission line and the connection line.

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#### CLAIMS

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[Claim(s)]

[Claim 1] It is the high frequency switch module which carried out laminating unification at the laminated circuit board equipped with the side face which connects between the 1st and 2nd principal planes which

come to carry out the laminating of two or more dielectric layers, and carry out phase opposite of the high frequency switch equipped with a radio-frequency head article, the transmission line, and a capacitor, and the principal plane concerned. While carrying said RF component in said laminated circuit board, said transmission line, The transmission line which builds in said capacitor and is built in the RF components carried in said laminated circuit board, and said laminated circuit board, The high frequency switch module characterized by having arranged the path cord way which connects a capacitor to the dielectric layer near said 1st principal plane, and having arranged the grand electrode which constitutes the capacitor of a high frequency switch between the layers of said transmission line and said path cord way.

[Claim 2] The high frequency switch module according to claim 1 characterized by for said radio-frequency head articles being a switching element or a switching element, and an SAW filter, and said switching element being diode or the electrolysis effectiveness mold transistor.

[Claim 3] Said high frequency switch is a high frequency switch module according to claim 1 or 2 characterized by having the switching element which grounds the transmission-line [ which has been arranged between a sending circuit, the switching element arranged between antennas, the transmission line or the chip inductor which grounds the sending-circuit side of the switching element concerned, and an antenna and a receiving circuit ], and receiving-circuit side of the transmission line concerned, and a capacitor.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the high frequency switch module which deals with a transceiver system with at least one antenna about the high frequency composite part used in high frequency bands, such as a semi-microwave band.

[0002]

[Description of the Prior Art] Development of the mobile communication equipment represented by the portable telephone etc. has a remarkable thing these days. There is a RF switch used as RF components used for this mobile communication equipment in order to switch connection between an antenna and a sending circuit and connection between an antenna and a receiving circuit. This high frequency switch is indicated by JP, 2-108301, A, and it has lambda / 4 phase tracks which have been arranged between a sending circuit, the diode arranged between antennas, and an antenna and a receiving circuit, and the receiving-circuit side of lambda / 4 phase tracks is grounded through diode, and constitutes lambda / 4 mold switching circuit which switches a signal path according to the bias current which has and flows to each diode. Moreover, there is a high frequency switch module which carried out the layered product unification of such lambda / a 4 mold switching circuit using the low-temperature-sintering dielectric ceramic ingredient (for example, refer to JP, 6-197040, A). Although these high frequency switches deal with only one transceiver system, the high frequency switch modules (for example, GSM-Glabal System for Mobile Communications, DCS-Digital Cellular System, PCS-Personal Communications Service, etc.) (for example, JP, 11-225089, A) constituted using a splitter and a high frequency switch so that two or more transceiver systems may be dealt with are also developed.

[0003]

[Problem(s) to be Solved by the Invention] Drawing 7 is the appearance perspective view of the conventional high frequency switch module. This high frequency switch module deals with two transceiver systems of GSM and DCS, and is equipped with a splitter, two high frequency switches, and low pass filters like the equal circuit shown in drawing 8 . The laminated circuit board of 6750 configurations which come to carry out [ the laminating of two or more dielectric layers ] the RF components (diodes DP1, DP2, DG1, and DG2) which constitute these is carried, and the transmission line and a capacitor are built in a laminated circuit board, and it is constituted. Moreover, some capacitors CG1 and CG2 are carried as a chip. Although arranged in this high frequency switch module to the circuit board in which the resistance in said equal

circuit, an inductor, etc. are not built in or carried in a laminated circuit board, but a high frequency switch module is mounted, suitably, these accept the need, are built in or carried and are constituted by the laminated circuit board.

[0004] Drawing 9 is the decomposition top view of said laminated circuit board. 1st near [ in which said RF component is carried ] the principal plane of a laminated circuit board (the 2nd layer), RF components and the transmission line, The path cord way SL which connects a capacitor is formed. The 3rd lower layer layer, LP3 and LG3 which constitute the transmission lines LF1, LF2, and LF3 which constitute a splitter, and a low pass filter were formed in the 4th layer, and the capacitors CF1, CF2, and CP6 of a splitter were formed in the 5th layer. As mentioned above, since a path cord way and the transmission line were arranged extremely in near, when it was going to miniaturize the high frequency switch module, there was a problem that desired electrical characteristics were not acquired by electromagnetism-interference.

[0005] moreover, the capacitor which constitutes a high frequency switch and a low pass filter -- the laminated circuit board of the 5th layer to the 9th layer -- it is mostly formed in a central field. Connection between the radio-frequency head article mounted in the 1st principal plane of a dielectric substrate, and the capacitor and the transmission line which are built in a laminated circuit board is made with the external electrode formed in the side face which connects between the 1st and 2nd principal planes of a through hole (it expresses as with a circle [ drawing bullet ]), or a laminated circuit board, and the principal plane concerned. The connection between the capacitors CP6 and CG6 linked to the switching elements DG2 and DP2 which ground the receiving-circuit side of the transmission lines LG2 and LP2 arranged between the antenna of a high frequency switch, and a receiving circuit by the conventional high frequency module, and said radio-frequency head article for example, the capacitor CG 6 It connects through the through hole formed in layer [ 1st ] - the 7th layer, and a capacitor CP 6 is connected through the through hole formed in layer [ 1st ] - the 4th layer. since switching elements DG2 and DP2 are turned on suitably, respectively and a high frequency switch is grounded in high frequency at the time of GSM and DCS transmission -- the connection with said switching element and capacitor -- setting -- a conductor -- it is desirable to connect for a short distance as it can avoid producing resistance loss, when raising electrical characteristics. however -- the conventional high frequency switch module -- a capacitor -- since [ of a laminated circuit board ] it is mostly formed in a central field --

connection distance with a radio-frequency head article -- long -- not taking -- not obtaining -- a result -- electrical characteristics -- improving -- making -- things -- the case of being difficult -- it was . [0006] As for the components used in the high frequency circuit where the above-mentioned high frequency switch module is used, it is common to set the value of a characteristic impedance to 50 ohms. Therefore, an ideal designs a high frequency switch so that a characteristic impedance may be set to 50 ohms in near the frequency of an input signal. Although determined by the distance from a ground electrode, the width of face of the transmission line, etc., when it was going to set the characteristic impedance of a high frequency switch as 50 ohms while a miniaturization and low back-ization of a high frequency switch module progressed, since grand inter-electrode spacing became small, in the track width of face of the transmission lines LP2 and LG2 of a high frequency switch, this characteristic impedance did not obtain a thin kink colander, but, as a result, had the problem which resistance of the transmission line increases and carries out resistance loss size. Then, this invention is made in order to cancel such a trouble, and it aims at obtaining the high frequency switch module which can be miniaturized, maintaining electrical characteristics.

[0007]

[Means for Solving the Problem] This invention a high frequency switch equipped with a radio-frequency head article, the transmission line, and a capacitor While being the high frequency switch module which carried out laminating unification and carrying said radio-frequency head article in the laminated circuit board equipped with the side face which comes to carry out the laminating of two or more dielectric layers, and connects between the 1st and 2nd principal planes which carry out phase opposite, and the principal plane concerned at said laminated circuit board The transmission line which builds in said transmission line and said capacitor and is built in the RF components carried in said laminated circuit board, and said laminated circuit board, It is the high frequency switch module which has arranged the path cord way which connects a capacitor to the dielectric layer near said 1st principal plane, and has arranged the ground electrode which constitutes the capacitor of a high frequency switch between the layers of said transmission line and said path cord way. In this invention, it is desirable to make said radio-frequency head article into a switching element or a switching element, and an SAW filter, and to use said switching element \*\* as IODO or the electrolysis effectiveness mold transistor. The switching element which grounds the transmission-line

[ which has been arranged between a sending circuit the switching element arranged between antennas, the transmission line or the chip inductor which grounds the sending-circuit side of the switching element concerned, and an antenna and a receiving circuit ], and receiving-circuit side of the transmission line concerned, and the configuration equipped with a capacitor of said high frequency switch are desirable.

[0008]

[Embodiment of the Invention] The example of this invention is explained using drawing 6 from drawing 1 . Drawing 1 is the appearance perspective view of the high frequency switch module of this invention, drawing 2 is the equal circuit, and drawing 3 is the decomposition top view of a laminated circuit board. this example -- if it is -- a laminated circuit board -- as the radio-frequency head article of a high frequency switch -- an SAW filter -- Resistance R1 and R2 and capacitors CG1, CG7, CG8, CP7, and CP8 are carried in diodes DG1, DG2, DP1, and DP2 and others. Capacitors CG6 and CP6 and the transmission lines LG2 and LP2 are built in, and the capacitor and the transmission line which constitute the capacitor which constitutes a low pass filter, the transmission line, and a splitter are built in said laminated circuit board, respectively. Said laminated circuit board prepares the green sheet which consists for example, of an alumina system glass ceramic low-temperature-sintering ingredient, on the green sheet, prints conductive paste, such as Ag, Pd, and Cu, forms a desired electrode pattern, carries out the laminating of it suitably, is made to really calcinate it, and is constituted. In addition, the range of the thickness of a sheet is 20-250 micrometers, and it is controlled by the use application with a doctor blade method etc. After carrying out the laminating of the big sheet in which many internal electrode patterns, such as a predetermined capacitor, the transmission line, and a path cord way, were formed and cutting to each chip size, it calcinates, a terminal electrode is formed and a laminated circuit board is produced. On the surface of the laminated circuit board, the terminal electrode linked to said internal electrode pattern is formed, and solder plating or Au plating is performed and it enables it to obtain solder wettability enough. The terminal electrode for mounting said radio-frequency head article etc. is formed in the 1st principal plane, and the terminal electrode for connection with the circuit board in which a high frequency switch module is mounted is formed in the 2nd principal plane. Solder printing is performed to the terminal electrode formed [ 1st ] in said principal plane using a metal mask, and reflow soldering of a PIN diode, a chip capacitor, an SAW filter which capacity value was not able to form in the laminating element assembly greatly,

etc. is carried and carried out to it after that.

[0009] Hereafter, the configuration of each class of a laminated circuit board is explained sequentially from the maximum upper layer. First, on the 1st layer, the diode, the chip, and the terminal electrode (land) of an SAW filter which are carried in a top face are formed. On the 2nd layer, the path cord way SL of the diode and the chip which are carried in a top face, and an internal electrode pattern is formed. On the 3rd layer, the electrode for capacitors CG [ CP6 and ] 6 of a high frequency switch is formed, and he is trying to connect with a radio-frequency head article on top for a short distance extremely. On the 4th layer, the grand electrode GND which constitutes said capacitors CP6 and CG6, and other electrodes CF 4 for capacitors are formed. If the electrode for said capacitors CG [ CP6 and ] 6, the grand electrode GND, and at least 20 micrometers or more of said path cord ways SL are made to estrange and it arranges, they can constitute the effect of stray capacity small. If clearance is less than 20 micrometers, electrical characteristics will deteriorate remarkably under the effect of said stray capacity. On the 5th layer and the 6th layer, the electrode for capacitors CF [ CG6, CF4, and ] 2 is formed, and the transmission line which constitutes a splitter, a low pass filter, and a high frequency switch is formed in the 12th layer from the 7th layer. As for the transmission line formed in this layer, it is desirable to arrange except for what is connected mutually, so that it may not overlap in the direction of a laminating. On the 13th layer and the 14th layer, the electrode for capacitors CF [ CG3, CG4, CF1, CP3, CP4, and ] 3 is formed. As for the capacitor formed in this layer, it is desirable to choose and arrange what is not continuously connected with mounting components, such as RF components on top, and the thing linked to the terminal electrode formed in the 2nd principal plane. On the layer [ 15th ] lowest layer, the grand electrode GND is formed mostly on the whole surface. The ground stabilized by this is securable.

[0010] A grand electrode can protect that the path cord way SL and the transmission line which constitutes a high frequency switch, a low pass filter, etc. carry out magnetic coupling with constituting as mentioned above. Moreover, since the transmission line can be constituted from track width of face of extent which does not affect electrical characteristics even if it can secure distance with the grand electrode of the 15th layer and is a miniaturization, especially the case where it thin-shape-izes, about a laminated circuit board when making said transmission line into a desired characteristic impedance since the grand electrode was formed in the 4th layer, the small high frequency

switch module of 5440 configurations can be obtained, having and maintaining electrical characteristics.

[0011] Next, other examples are explained. Drawing 4 is the element-placement top view of the high frequency switch module of this invention, drawing 5 is the equal circuit and drawing 6 is the decomposition top view of a laminated circuit board. this example -- even if it is -- a laminated circuit board -- as the radio-frequency head article of a high frequency switch -- an SAW filter -- Resistance R1 and R2 and capacitors CG1, CG7, CG8, CP7, and CP8 are carried in diodes DG1, DG2, DP1, and DP2 and others. Capacitors CG6 and CP6 and the transmission lines LG2 and LP2 are built in, and the capacitor and the transmission line which constitute the capacitor which constitutes a low pass filter, the transmission line, and a splitter are built in said laminated circuit board, respectively.

[0012] In this example, the electrode for capacitors CF [ CF2 and ] 4 which constitutes a splitter is formed in the 5th layer from the 3rd layer with the electrode for capacitors CP [ CG6 and ] 6, and the grand electrode GND. In this example, since it is the structure which sandwiches the electrode for capacitors CP [ CG6 and ] 6 with the grand electrode of two sheets, parasitic capacitance is not generated between said capacitor electrodes and terminal electrodes of the 1st principal plane. Thus, maintaining electrical characteristics, even if constituted, the small high frequency switch module could be obtained and it came.

[0013] moreover, this invention -- setting -- a laminated circuit board -- the large grand electrode of the lowest layer to an electrode surface product, and an electrode surface product -- since laminating formation is carried out in a symmetrical form on the basis of the middle class by order called a small transmission-line layer and the large grand electrode layer of an electrode surface product and an electrode layer can be arranged with balance conventionally more sufficient than structure, there is effectiveness also in deformation prevention of the laminated circuit board at the time of sintering.

[0014]

[Effect of the Invention] According to this invention, the high frequency switch module which can respond to a miniaturization can be offered. This becomes effective in a microminiaturization of a device in a multi-band cellular phone etc.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the appearance perspective view of the high frequency switch module of one example concerning this invention.

[Drawing 2] It is the equal circuit of the high frequency switch module of one example concerning this invention.

[Drawing 3] It is the decomposition top view of a laminated circuit board used for one example concerning this invention.

[Drawing 4] It is the appearance perspective view of the high frequency switch module in other examples concerning this invention.

[Drawing 5] It is the equal circuit of the high frequency switch module in other examples concerning this invention.

[Drawing 6] It is the decomposition top view of a laminated circuit board used for other examples concerning this invention.

[Drawing 7] It is the appearance perspective view of the conventional high frequency switch module.

[Drawing 8] It is the equal circuit of the conventional high frequency switch module.

[Drawing 9] It is the decomposition top view of the conventional laminated circuit board.

[Description of Notations]

- 1 High Frequency Switch Module
- 2 Laminated Circuit Board

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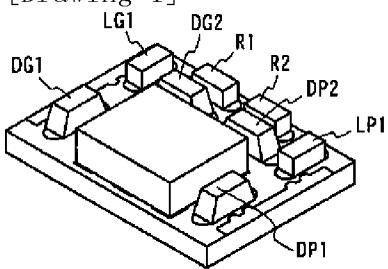
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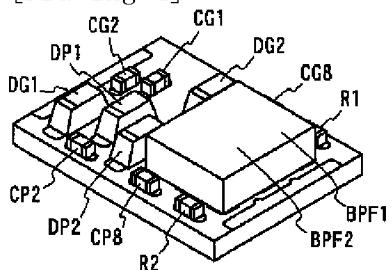
## DRAWINGS

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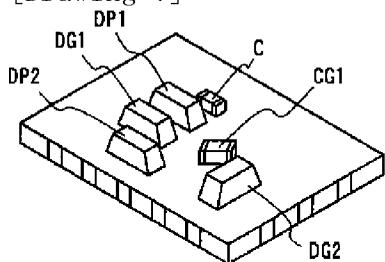
[Drawing 1]



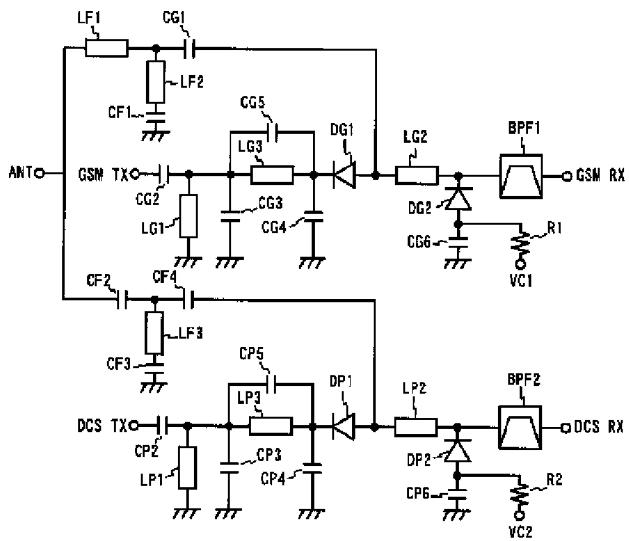
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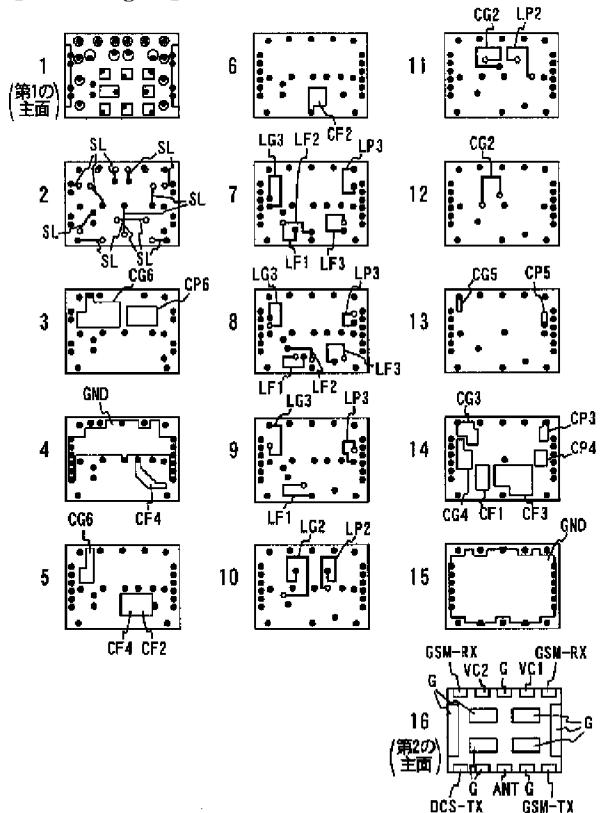
[Drawing 7]



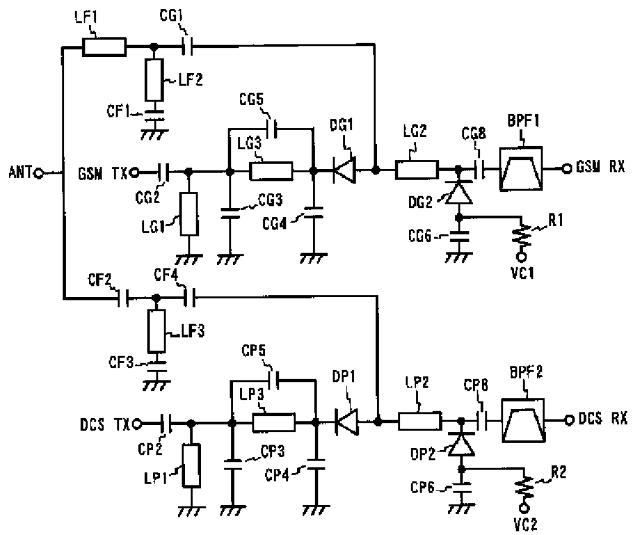
[Drawing 2]



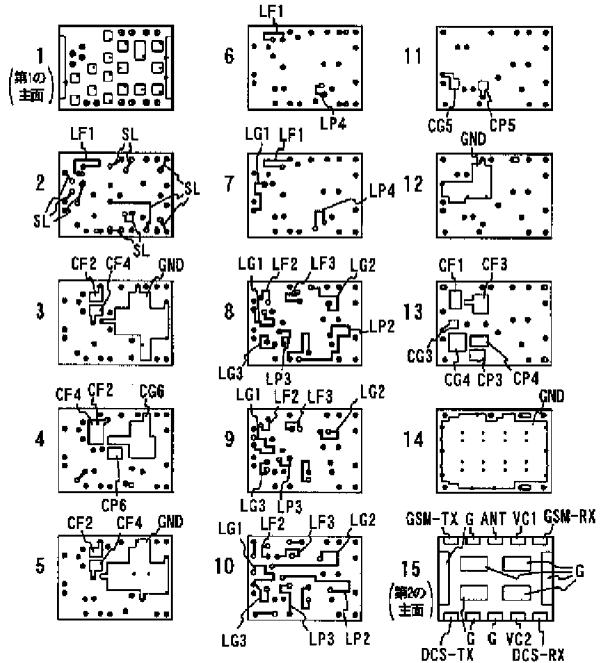
[Drawing 3]



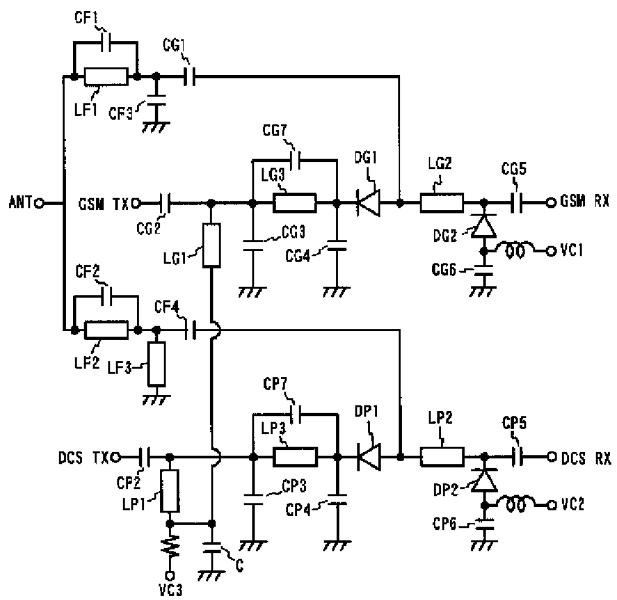
[Drawing 5]



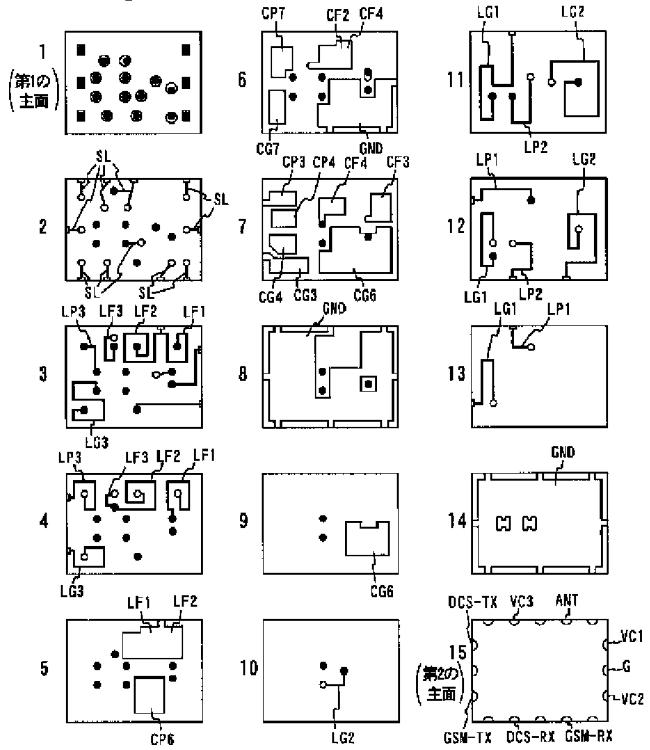
[Drawing 6]



[Drawing 8]



[Drawing 9]




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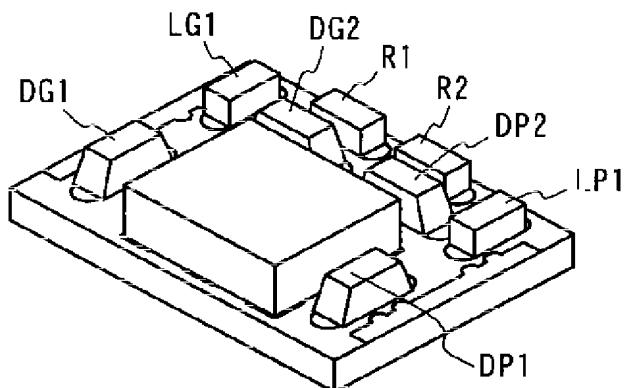
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KA05 KA18

(54)【発明の名称】 高周波スイッチモジュール

(57)【要約】

【課題】 電気的特性を維持しながら小型化可能な高周波スイッチモジュールを得ることを目的とする。

【解決手段】 高周波部品、伝送線路、コンデンサを備える高周波スイッチを、複数の誘電体層を積層してなり相対向する第1および第2の主面と当該主面間を連結する側面を備えた積層基板に積層一体化した高周波スイッチモジュールであって、前記積層基板に前記高周波部品を搭載するとともに、前記伝送線路、前記コンデンサを内蔵し、前記積層基板に搭載される高周波部品と前記積層基板に内蔵される伝送線路、コンデンサを接続する接続線路を前記第1の主面の近傍の誘電体層に配置し、前記伝送線路と前記接続線路との層間に、高周波スイッチのコンデンサを構成するグランド電極を配置したことを特徴とした。



**【特許請求の範囲】**

**【請求項1】** 高周波部品、伝送線路、コンデンサを備える高周波スイッチを、複数の誘電体層を積層してなり相対向する第1および第2の主面と当該主面間を連結する側面を備えた積層基板に積層一体化した高周波スイッチモジュールであって、前記積層基板に前記高周波部品を搭載するとともに、前記伝送線路、前記コンデンサを内蔵し、前記積層基板に搭載される高周波部品と前記積層基板に内蔵される伝送線路、コンデンサを接続する接続線路を前記第1の主面の近傍の誘電体層に配置し、前記伝送線路と前記接続線路との層間に、高周波スイッチのコンデンサを構成するグランド電極を配置したことを特徴とする高周波スイッチモジュール。

**【請求項2】** 前記高周波部品がスイッチング素子又は、スイッチング素子とSAWフィルタであり、前記スイッチング素子がダイオード又は電解効果型トランジスタであることを特徴とする請求項1に記載の高周波スイッチモジュール。

**【請求項3】** 前記高周波スイッチは、送信回路とアンテナの間に配置されたスイッチング素子と、当該スイッチング素子の送信回路側を接地する伝送線路又はチップインダクタと、アンテナと受信回路との間に配置された伝送線路と、当該伝送線路の受信回路側を接地するスイッチング素子とコンデンサを備えることを特徴とする請求項1又は2に記載の高周波スイッチモジュール。

**【発明の詳細な説明】****【0001】**

**【発明の属する技術分野】** 本発明は準マイクロ波帯などの高周波帯域で用いられる高周波複合部品に関し、少なくとも1つのアンテナで送受信系を取り扱う高周波スイッチモジュールに関する。

**【0002】**

**【従来の技術】** 昨今、携帯電話機等に代表される移動体通信機器の発展は目覚しいものがある。この移動体通信機器に用いられる高周波部品として、アンテナと送信回路との接続、アンテナと受信回路との接続を切換えるために使用される高周波スイッチがある。この高周波スイッチは、例えば特開平2-108301号に開示され、送信回路とアンテナの間に配置されたダイオードと、アンテナと受信回路との間に配置された入/4位相線路とを有し、入/4位相線路の受信回路側はダイオードを介して接地されており、もって各ダイオードに流れるバイアス電流により信号経路を切換える入/4型スイッチ回路を構成している。また、このような入/4型スイッチ回路を、低温焼結誘電体セラミック材料を用い積層体一体化した高周波スイッチモジュールがある（例えば特開平6-197040号公報参照）。これらの高周波スイッチは一つの送受信系のみを取り扱うものであるが（例えばGSM-Glabal System for Mobile Communications, DCS-Digital Cellular System, PCS-Personal Comm

unications Service等）、二つ以上の送受信系を取り扱うように分波器と高周波スイッチを用いて構成される高周波スイッチモジュール（例えば特開平11-225089号）も開発されている。

**【0003】**

**【発明が解決しようとする課題】** 図7は、従来の高周波スイッチモジュールの外観斜視図である。この高周波スイッチモジュールは、GSMとDCSとの2つの送受信系を取り扱うものであり、図8に示す等価回路のように、分波器と2つの高周波スイッチとローパスフィルタを備える。これらを構成する高周波部品（ダイオードDP1, DP2, DG1, DG2）を複数の誘電体層を積層してなる6750形状の積層基板を搭載し、伝送線路、コンデンサを積層基板に内蔵して構成される。また、一部のコンデンサCG1, CG2をチップ部品として搭載している。この高周波スイッチモジュールでは前記等価回路における抵抗、インダクタ等を積層基板に内蔵もしくは搭載せず、高周波スイッチモジュールが実装される回路基板に配置しているが、これらは適宜、必要に応じて積層基板に内蔵もしくは搭載して構成される。

**【0004】** 図9は前記積層基板の分解平面図である。前記高周波部品が搭載される積層基板の第1の主面近傍（第2層）には高周波部品と伝送線路、コンデンサを接続する接続線路SLが形成されており、その下層の第3層、第4層に分波器を構成する伝送線路LF1, LF2, LF3、ローパスフィルタを構成するLP3, LG3が形成され、第5層には分波器のコンデンサCF1, CF2, CP6が形成されていた。上記のように、接続線路と伝送線路が極めて近傍に配置されている為、高周波スイッチモジュールを小型化しようとすると、電磁気的な干渉により所望の電気的特性が得られないといった問題があった。

**【0005】** また、高周波スイッチとローパスフィルタを構成するコンデンサが第5層から第9層の、積層基板のほぼ中央領域に形成される。誘電体基板の第1の主面に実装される高周波部品等と、積層基板に内蔵されるコンデンサ、伝送線路との接続はスルーホール（図中黒丸で表示）や積層基板の第1および第2の主面と当該主面間を連結する側面に形成された外部電極によって行う。従来の高周波モジュールでは、高周波スイッチのアンテナと受信回路との間に配置された伝送線路LG2, LP2の受信回路側を接地するスイッチング素子DG2, DP2に接続するコンデンサCP6, CG6と前記高周波部品との接続は、例えばコンデンサCG6は、第1層～第7層に形成されたスルーホールを介して接続し、コンデンサCP6は、第1層～第4層に形成されたスルーホールを介して接続される。高周波スイッチは、GSM、DCS送信時において、スイッチング素子DG2, DP2がそれぞれ適宜ONされ高周波的に接地されるため、前記スイッチング素子とコンデンサとの接続においては、

導体抵抗損を生じないように出来るだけ近距離で接続するのが、電気的特性を向上させる上で好ましい。しかしながら、従来の高周波スイッチモジュールでは、コンデンサが積層基板のほぼ中央領域に形成されるため、高周波部品との接続距離を長く取らざるを得ず、結果電気的特性を向上させることができることが困難な場合があった。

【0006】上記高周波スイッチモジュールが用いられる高周波回路で用いられる部品は、特性インピーダンスの値を $50\Omega$ とするのが一般的である。したがって高周波スイッチは受信信号の周波数付近において特性インピーダンスが $50\Omega$ となるように設計するのが理想である。この特性インピーダンスは、グランド電極からの距離、伝送線路の幅等により決定されるが、高周波スイッチモジュールの小型化・低背化が進む中で高周波スイッチの特性インピーダンスを $50\Omega$ に設定しようとすれば、グランド電極間の間隔が小さくなることから、高周波スイッチの伝送線路L P 2、L G 2の線路幅を細くせざるを得ず、その結果伝送線路の抵抗が増加してしまい抵抗損失大させる問題があった。そこで本発明は、このような問題点を解消する為になされたものであり、電気的特性を維持しながら小型化可能な高周波スイッチモジュールを得ることを目的とするものである。

#### 【0007】

【課題を解決するための手段】本発明は、高周波部品、伝送線路、コンデンサを備える高周波スイッチを、複数の誘電体層を積層してなり相対向する第1および第2の主面と当該主面間を連結する側面を備えた積層基板に積層一体化した高周波スイッチモジュールであって、前記積層基板に前記高周波部品を搭載するとともに、前記伝送線路、前記コンデンサを内蔵し、前記積層基板に搭載される高周波部品と前記積層基板に内蔵される伝送線路、コンデンサを接続する接続線路を前記第1の主面の近傍の誘電体層に配置し、前記伝送線路と前記接続線路との層間に、高周波スイッチのコンデンサを構成するグランド電極を配置した高周波スイッチモジュールである。本発明においては、前記高周波部品をスイッチング素子又は、スイッチング素子とSAWフィルタとし、前記スイッチング素子がをイオード又は電解効果型トランジスタとするのが好ましい。前記高周波スイッチは、送信回路とアンテナの間に配置されたスイッチング素子と、当該スイッチング素子の送信回路側を接地する伝送線路又はチップインダクタと、アンテナと受信回路との間に配置された伝送線路と、当該伝送線路の受信回路側を接地するスイッチング素子とコンデンサを備える構成が好ましい。

#### 【0008】

【発明の実施の形態】本発明の実施例について、図1から図6を用いて説明する。図1は本発明の高周波スイッチモジュールの外観斜視図であり、図2はその等価回路であり、図3は積層基板の分解平面図である。本実施例

においては、積層基板に高周波スイッチの高周波部品としてSAWフィルタ、ダイオードD G 1、D G 2、D P 1、D P 2と他に抵抗R 1、R 2、コンデンサC G 1、C G 7、C G 8、C P 7、C P 8を搭載し、コンデンサC G 6、C P 6、伝送線路L G 2、L P 2を内蔵し、ローパスフィルタを構成するコンデンサ、伝送線路、分波器を構成するコンデンサ、伝送線路をそれぞれ、前記積層基板に内蔵している。前記積層基板は、例えばアルミニナ系ガラスセラミック低温焼結材料からなるグリーンシートを用意し、そのグリーンシート上にA g、P d、C u等の導電ペーストを印刷して、所望の電極パターンを形成し、それを適宜積層し、一体焼成させて構成される。なお、シートの厚さは $20\sim 250\mu m$ の範囲で、使用用途によりドクターブレード法などで制御される。所定のコンデンサ、伝送線路、接続線路等の内部電極パターンを多数形成した大きなシートを積層し、1つ1つのチップサイズに切断した後、焼成し、端子電極を形成して積層基板を作製する。積層基板の表面には、前記内部電極パターンと接続する端子電極が形成されており、半田メッキまたはA uメッキを施し半田濡れ性を十分得られるようにしている。第1の主面には、前記高周波部品等を実装するための端子電極が形成され、第2の主面には、高周波スイッチモジュールが実装される回路基板との接続のための端子電極が形成される。前記第1に主面に形成された端子電極には、メタルマスクを使用して半田印刷を施し、その後P I Nダイオードや、容量値が大きく積層素体内に形成出来なかつたチップコンデンサ、SAWフィルタなどを搭載し、リフロー半田付する。

【0009】以下、積層基板の各層の構成を、最上層から順に説明する。まず、第1層上には、上面に搭載するダイオードやチップ部品やSAWフィルタの端子電極（ランド）を形成している。第2層上には、上面に搭載するダイオードやチップ部品と内部電極パターンとの接続線路S Lが形成されている。第3層上には、高周波スイッチのコンデンサC P 6、C G 6用電極が形成され上面の高周波部品と極めて近距離で接続するようになっている。第4層上には、前記コンデンサC P 6、C G 6を構成するグランド電極G NDと他のコンデンサ用電極C F 4が形成されている。前記コンデンサC P 6、C G 6用電極やグランド電極G NDと、前記接続線路S Lとは、少なくとも $20\mu m$ 以上離間させて配置すれば、浮遊容量の影響を小さく構成することが出来る。離間距離が $20\mu m$ 未満だと、前記浮遊容量の影響で電気的特性が著しく劣化する。第5層、第6層上にはコンデンサC G 6、C F 4、C F 2用電極が形成され、第7層から第12層には、分波器、ローパスフィルタ、高周波スイッチを構成する伝送線路が形成されている。この層に形成される伝送線路は、互いに接続されているものを除いて、積層方向に重なり合わないように配置するのが好まし

い。第13層、第14層上には、コンデンサCG3、CG4、CF1、CP3、CP4、CF3用電極が形成される。この層に形成するコンデンサは上面の高周波部品等の実装部品と連続して接続しないものや、第2の主面に形成された端子電極に接続するものを選択し配置するのが好ましい。最下層の第15層上には、グランド電極GNDがほぼ全面に形成されている。これにより安定したアースが確保できる。

【0010】上記のように構成することで、接続線路SLと高周波スイッチ、ローパスフィルタ等を構成する伝送線路とが磁気結合するのをグランド電極で防ぐことが出来る。また第4層にグランド電極を形成したので、前記伝送線路を所望の特性インピーダンスにする場合に、第15層のグランド電極との距離を確保でき、積層基板を小型化、特には薄型化する場合であっても、電気的特性に影響を与えない程度の線路幅で伝送線路を構成することができるので、もって電気的特性を維持しながら5440形状の小型の高周波スイッチモジュールを得ることが出来る。

【0011】次に他の実施例について説明する。図4は本発明の高周波スイッチモジュールの部品搭載平面図であり、図5はその等価回路であり、図6は積層基板の分解平面図である。本実施例においても、積層基板に高周波スイッチの高周波部品としてSAWフィルタ、ダイオードDG1、DG2、DP1、DP2と他に抵抗R1、R2、コンデンサCG1、CG7、CG8、CP7、CP8を搭載し、コンデンサCG6、CP6、伝送線路LG2、LP2を内蔵し、ローパスフィルタを構成するコンデンサ、伝送線路、分波器を構成するコンデンサ、伝送線路をそれぞれ、前記積層基板に内蔵している。

【0012】本実施例では、分波器を構成するコンデンサCF2、CF4用電極を第3層から第5層に、コンデンサCG6、CP6用電極、グランド電極GNDとともに形成している。本実施例においては、2枚のグランド電極でコンデンサCG6、CP6用電極を挟む構造であるため、前記コンデンサ電極と第1の主面の端子電極と

の間で寄生容量を発生させない。このように構成しても電気的特性を維持しながら小型の高周波スイッチモジュールを得ることが出来た。

【0013】また本発明においては、積層基板を、最下層から電極面積の大きいグランド電極、電極面積小さい伝送線路層、電極面積の大きいグランド電極層という順で中間層を基準に対称な形で積層形成するため、従来構造よりもバランスよく電極層を配置することが出来るので、焼結時における積層基板の変形防止にも効果がある。

#### 【0014】

【発明の効果】本発明によると、小型化に対応できる高周波スイッチモジュールを提供することができる。これにより、マルチバンド携帯電話などにおいて、機器の超小型化に有効となる。

#### 【図面の簡単な説明】

【図1】本発明に係る一実施例の高周波スイッチモジュールの外観斜視図である。

【図2】本発明に係る一実施例の高周波スイッチモジュールの等価回路である。

【図3】本発明に係る一実施例に用いた積層基板の分解平面図である。

【図4】本発明に係る他の実施例における高周波スイッチモジュールの外観斜視図である。

【図5】本発明に係る他の実施例における高周波スイッチモジュールの等価回路である。

【図6】本発明に係る他の実施例に用いた積層基板の分解平面図である。

【図7】従来の高周波スイッチモジュールの外観斜視図である。

【図8】従来の高周波スイッチモジュールの等価回路である。

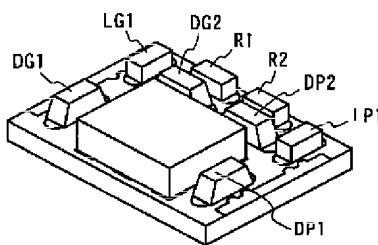
【図9】従来の積層基板の分解平面図である。

#### 【符号の説明】

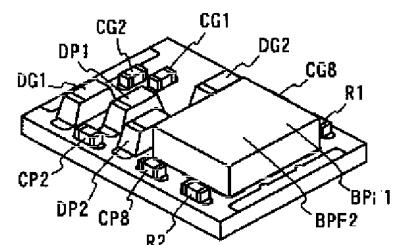
1 高周波スイッチモジュール

2 積層基板

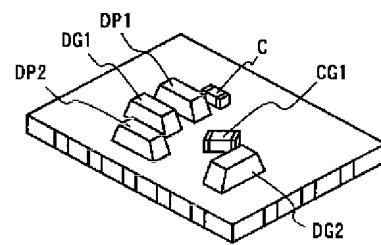
【図1】



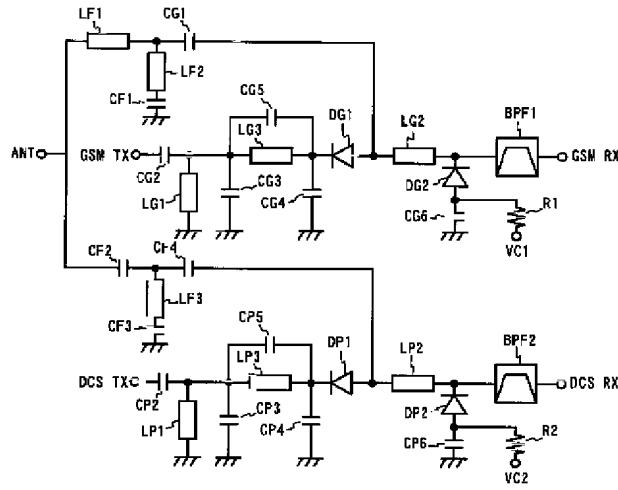
【図4】



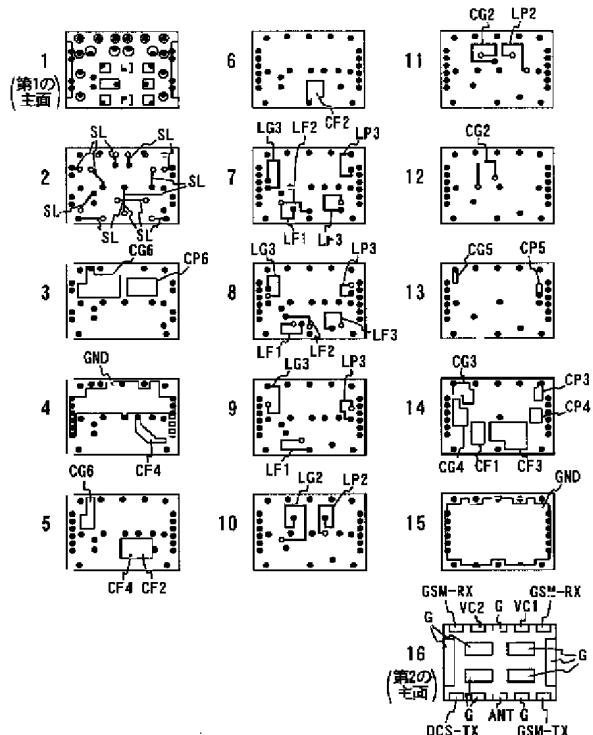
【図7】



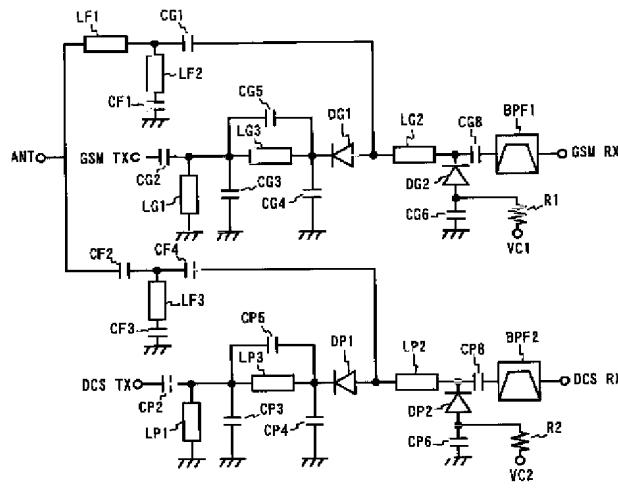
【図2】



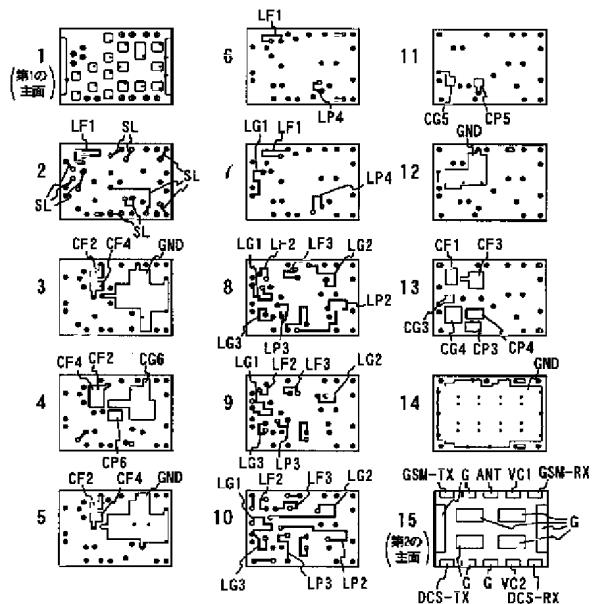
【図3】



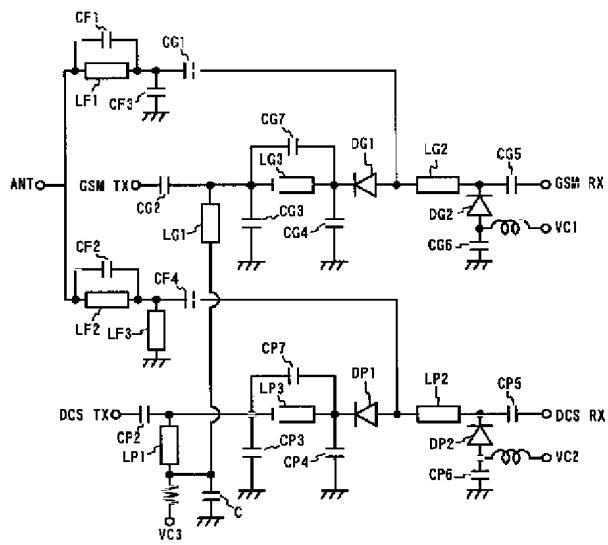
【図5】



【図6】



【図8】



【図9】

